

REMARKS*Status of the Application*

Upon entry of this amendment, Claims 1- 18 are pending in this case. Claims 14-18 have been allowed. Claims 1, 4, 6, 11-13 stand rejected under 35 U.S.C. §103 (a) as allegedly being obvious over U.S. Patent 5,977,980 (*Aleksicicy*) in view of U.S. Patent 5,596,686 (*Duluk, Jr.*). Claims 14-16 and 18 stand rejected under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent 5,579,455 (*Green et al.*). Claims 2-3, 5, 7-10, stand rejected under 35 U.S.C. §103(a) as allegedly being obvious over *Aleksicicy* in view of *Duluk, Jr.* and further in view of U.S. Patent 6,091,422 (*Ouaknine et al.*).

In view of the following remarks, Applicants respectfully request reconsideration of the present application and an early Notice of Allowance.

*35 U.S.C. § 103(a) Rejections*Prima Facie Obviousness

To establish a *prima facie* case of obviousness, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine reference teachings. Further, there must be a reasonable expectation of success after combining the references the intended purpose of the invention is realized. **Lastly, the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior

art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Applicants respectfully submit that a *prima facie* case of obviousness has not been made for claims 1-24 of the present application.

The Present Invention

The present invention contemplates a system and methods that realize early occlusion culling. In an illustrative implementation, a graphics display screen is divided into a series of tiles arranged as a rectangular grid. The rectangular grid, or coarse Z-buffer may have various sizes and dimensions. Each tile within the coarse Z-buffer has an associated depth value. Further, each tile's depth value is defined as the farther Z-buffer value that is included within the tile. In operation, the graphics pipeline is configured to update the depth values using information fed back from the Z-buffer. In an effort to maximize the effectiveness of the occlusion culling, the graphics pipeline may be configured to perform these updates on a synchronous basis. As a result, the depth values are updated each time the corresponding Z-values in the Z-buffer are changed. The depth values are stored in a location, such as main memory, where they may be available to application programs. This allows application programs to reference these values while they are creating graphics images.

Generally, the application program rendering the image constructs a surrogate volume for each object that it adds to the image. The program then compares the nearest Z-value of the surrogate volume to the depth value of the tile that includes the surrogate volume. Based on this

comparison, the application program is capable of determining if the object that is being rendered is occluded and can be discarded.

Differences from Aleksicy

Aleksicy discloses an apparatus and method for determining visibility of a pixel during video rendering. The visibility is accomplished by determining z-positioning information of an object element that is being rendered. The z-positioning information is representative of the z-information of an object element in a particular section of the display. For example. The z-positioning information may be the two most significant bits of the z-parameter, or information of an object element. .

In contrast to the inventions of Applicants' claims 1, however, the systems and methods taught by Aleksicy does not teach a system and methods that provide early occlusion culling wherein a display area is modeled as a coarse z-buffer being having a make-up of tiles, wherein each tile is associated a depth value, and wherein the depth value is used by applications to compare objects to be rendered so as to remove occluded objects. Rather, Aleksicy teaches an apparatus and method that assigns z-positioning information to object elements to be rendered in a display area. Furthermore, as Examiner states Aleksicy "**does not explicitly disclose the coarse Z-buffer subdivide into a series of tiles.**" (Page 2 of Last Official Action dated January 29, 2002 – Paper 8). In the current Official Final Rejection Action, the Examiner **now** states that Aleksicy teaches the use of a tiled coarse Z-buffer. (See Current Official Final Rejection Action – Page 7, "Response to Arguments" section). Applicants respectfully submit that the

Examiner is in direct contradiction with the Examiner's earlier statement and in essence would "like to have his cake and eat it too." It is clear that the Examiner is trying to back track to state that *Aleksicy* teaches something that the Examiner clearly stated on a previous occasion it did not. Simply, *Aleksicy* does not teach the use of a **coarse tiled z-buffer** when processing graphics information to realize occluded culling.

Accordingly, *Aleksicy*, alone or when combined with the prior art of record, simply does not teach or even suggest to one skilled in the use of a tiled coarse Z-buffer having associated depth values to realize occluded culling. Since *Aleksicy*, alone or when combined with the prior art of record, does not teach or suggest to one skilled in the art every limitation of the present invention, a *prima facie* case of obviousness has not been made. For these reasons, Applicants respectfully request that the obviousness rejection be withdrawn.

Differences from *Duluk*

Duluk discloses an apparatus and method for a disclose a system and method for a parallel query Z-coordinate buffer. The apparatus and method perform a keep/discard decision on screen coordinate geometry before the geometry is converted or rendered into individual display screen pixels by implementing a parallel searching technique within a novel z-coordinate buffer based on a magnitude comparison content addressable memory (MCAMM) structure. In operation, the MCAMM provides a means for performing simultaneous arithmetic magnitude comparisons on numerical quantities.

In contrast to the inventions of Applicants' claims 1, however, the systems and methods taught by *Duluk* does not teach a system and methods that provide early occlusion culling wherein a display area is modeled as a coarse z-buffer being having a make-up of tiles, wherein each tile is associated a depth value, and wherein the depth value is used by applications to compare objects to be rendered so as to remove occluded objects. Rather, *Duluk* teaches an apparatus and method that perform comparisons on *already known* values for content queried from a z-buffer in a determination of keeping or discarding graphical content before rendering. *Duluk* does not explicitly or implicitly teach assigning depth values of a tile processed graphical display area as part of an effort of determining and discarding occluded graphical content.

As such, *Duluk*, alone or when combined with the prior art of record, simply does not teach or even suggest to one skilled in the use of a tiled coarse Z-buffer having associated depth values to realize occluded culling. Since *Duluk*, alone or when combined with the prior art of record, does not teach or suggest to one skilled in the art every limitation of the present invention, a *prima facie* case of obviousness has not been made. For these reasons, Applicants respectfully request that the obviousness rejection be withdrawn.

Differences from *Ouaknine et al.*

Ouaknine et al. disclose a computer 3D modeling and animation system that provides a user interface that allows users to make changes to 3D scene data while simultaneously allowing the author to view rendered images corresponding to those changes. The system provides tools associated with a 3D editing context as well as a rendered image that is automatically updated.

In operation, the speed of updating the rendering is increased by identifying and re-rendering only portions of the region that require it. This may be achieved by breaking an image to be rendered into tiles, some or portions of which may be subtended by the render region. The invention , in this case, may determine from the dimensions (coordinates) of the tiles, the particular scene modifications that are still current, and from the other scene data, the particular tiles that must be re-rendered.

In contrast to the inventions of Applicants' claims 1, however, the systems and methods taught by *Ouaknine et al.* do not teach a system and methods that provide early occlusion culling wherein a display area is modeled as a coarse z-buffer being having a make-up of tiles, wherein each tile is associated a depth value, and wherein the depth value is used by applications to compare objects to be rendered so as to remove occluded objects. Rather, *Ouaknine et al.* teach a system that allows for the more efficient editing of 3D images wherein images are broken down into tiles. The tiles are then processed during rendering to determine which portions of the image require modification (as a result of editing) and those that do not. *Ouaknine et al.*, however, do not explicitly or implicitly teach assigning depth values of a tile processed graphical display area as part of an effort of determining and discarding occluded graphical content.

As such, Ouaknine et al., alone or when combined with the prior art of record, simply do not teach or even suggest to one skilled in the use of a tiled coarse Z-buffer having associated depth values to realize occluded culling. Since Ouaknine et al., alone or when combined with the prior art of record, do not teach or suggest to one skilled in the art every limitation of the

present invention, a *prima facie* case of obviousness has not been made. For these reasons, Applicants respectfully request that the obviousness rejection be withdrawn.

Differences from *Greene et al.*

Greene et al. disclose a hierarchical Z-buffer scan-conversion algorithm that rejects hidden geometry of a model, and exploits the spatial and temporal coherence of the images being generated. The method employs two hierarchical data structures, an object-space octree and an image-space Z-pyramid, in order to accelerate scan conversion. The two hierarchical data structures make it possible to reject hidden geometry while rendering visible geometry with the speed of scan conversion. In operation, an image-space Z-pyramid is employed. The z-pyramid offers the ability to make a determination whether a large polygon is hidden, making it unnecessary to scan-convert the polygon. This may be accomplished by combining four Z values (a 2x2) window at each level into one Z value at the next coarser level by choosing the farthest Z from the observer.

In contrast to the inventions of Applicants' claims 1, however, the systems and methods taught by *Greene et al.* do not teach a system and methods that provide early occlusion culling wherein a display area is modeled as a coarse z-buffer being having a make-up of tiles, wherein each tile is associated a depth value, and wherein the depth value is used by applications to compare objects to be rendered so as to remove occluded objects. Rather, *Greene et al.* teach an algorithm that processes graphical content to remove hidden elements of an object model and to render visible geometry at the speed of scan conversion. *Greene et al.*, however, do not

explicitly or implicitly teach assigning depth values of a tile processed graphical display area as part of an effort of determining and discarding occluded graphical content.

As such, Greene et al., alone or when combined with the prior art of record, simply do not teach or even suggest to one skilled in the use of a tiled coarse Z-buffer having associated depth values to realize occluded culling. Since Greene et al., alone or when combined with the prior art of record, do not teach or suggest to one skilled in the art every limitation of the present invention, a *prima facie* case of obviousness has not been made. For these reasons, Applicants respectfully request that the obviousness rejection be withdrawn.

Claim Analysis:

Independent Claims 1 and 11-13:

Examiner has rejected independent claims 1, 11-13 as allegedly being obvious over *Aleksicy* and *Duluk*. Specifically, in Examiner's reading of the *Aleksicy*, the Examiner suggests that *Aleksicy* teaches a method for culling occluded objects from an image being rendered into a frame buffer, the method being performed by a host processor and comprising the steps of constructing a coarse z-buffer, the coarse Z-buffer being subdivided into a series of tiles each having an associated depth value. (Page 2 of Current Action citing to col. 2, lines 25-31, and Figure 1 of *Aleksicy*). Furthermore, Examiner suggests that *Duluk* teaches tile processing of graphical content. (Page 2 of Current Action).

Applicants respectfully disagree with the Examiner's reading of the *Aleksicy* and *Duluk* references. Specifically, *Aleksicy* teaches **the determination of visibility of a pixel during**

rendering by determining the z-positioning information the on object element. Applicants respectfully submit that one of ordinary skill in the art would not equate the use of z-positioning information to determine pixel visibility to the tile processing of graphical content and association of depth information for tile processed graphical content to determine occluded content. (See Claims 1 and 11-14, and 18). It is apparent that these steps operate very differently and thus are not similar or the same.

Comparatively, *Duluk* teaches a system and method that perform a keep/discard decision on screen coordinate geometry using a z-coordinate buffer based on MCCAM structure. However, as described previously, *Duluk*, fails to teach the association of depth values to tile processed graphical content when realizing the keep/discard decision.

Since the use of z-positioning information does not constitute tile processing of graphical content and association of depth information to tile-processed information in determining occluded content, Applicants respectfully submit that Aleksicy and Duluk, alone or in combination, do not render the independent claims 1, and 11-13 obvious.

Independent Claims 14 and 18:

Examiner has rejected independent claims 14, and 18 as allegedly being obvious over *Greene et al.* Specifically, in Examiner's reading of *Greene et al.*, the Examiner suggests that *Greene et al.*, teaches all of the limitations of independent claims 14 and 18 of the present application.

Applicants respectfully request some clarification from the Examiner with regards to the status of claims 14-18. The cover sheet of the current Official Action indicates that claims 14-18 have been allowed yet Examiner proffers a rejection under 35 U.S.C. Section 103(a) for claims 14-18. The Examiner is kindly requested to indicate the proper status of these claims.

Dependent Claims 2-10, and 15-17:

Examiner has rejected dependent claims 2-10, and 15-17 as being allegedly obvious over *Aleksicy, Duluk, Ouakine et al.*, and *Greene et al.* for reasons set forth in the present action. Inasmuch as claims 2-10 and 15-17 depend either directly or indirectly from independent claims 1, 11-13, 14, and 18 , Applicants respectfully submit that they too patentably define over the prior art of record for the same reasons.

Arguments Presented But Not Considered

Applicants respectfully request clarification from the Examiner with respect to the date of arguments considered when preparing the current Official Final Rejection Office Action. In the current Official Final Rejection Action, the Examiner states in the “Response to Arguments” section, that “Applicant’s arguments filed 5/15/01 have been fully considered by they are not persuasive.” Applicants respectfully submit, and as the record of this application shows, that Applicants have filed two additional responses in response to Official Actions that were filed on

November 12, 2001 and July 25, 2002, respectively. The Examiner is kindly requested to clarify whether the arguments found in the November 12, 2001 and July 25, 2002 responses were ever considered when drafting the current Official Final Rejection Action.

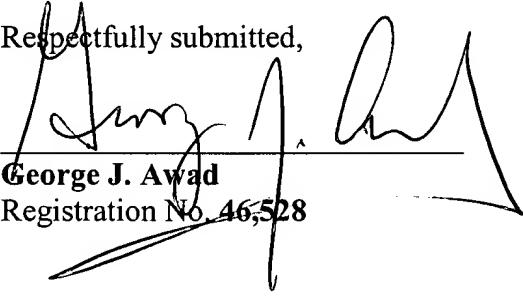
In the event that the Examiner merely engaged in a ministerial mistake and the arguments from the July 25, 2002 response were considered as part of the current Official Final Rejection Office Action, Applicants respectfully submit that the Examiner responded to only one of the Arguments proffered by Applicants. Accordingly, the Examiner is kindly requested to provide additional responses to the arguments provided in the July 25, 2002 response that have not yet been addressed.

CONCLUSION

For all the foregoing reasons, Applicants respectfully submit that claims 1-18 patentably define over the prior art of record. Reconsideration of the present Office Action and an early Notice of Allowance are respectfully requested.

Date: December 20, 2002

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